Original Article

Psychological correlates of patients' identity suffering from atrial septal defect (ASD) and patent foramen ovale (PFO)

Adrianna Skoczek[1], Paweł Prochownik[2], Urszula Gancarczyk[2], Natasza Libiszewska[2], Piotr Podolec[2], Natalia Podolec[2], Monika Komar[2]

[1]Science Club at The Clinical Department of Cardiac and Vascular Diseases with the Intensive Cardiac Supervision Subdivision, [2]The Clinical Department of Cardiac and Vascular Diseases with the Intensive Cardiac Supervision Subdivision, John Paul II Hospital, Institute of Cardiology, Collegium Medicum of the Jagiellonian University in Cracow, Cracow, Poland

Contributions: (I) Conception and design: A Skoczek, M Komar; (II) Administrative support: All authors; (III) Provision of study materials or patients: A Skoczek, P Podolec, M Komar; (IV) Collection and assembly of data: A Skoczek, P Prochownik, P Podolec, M Komar; (V) Data analysis and interpretation: A Skoczek, P Podolec, M Komar; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Adrianna Skoczek. Baczków 210, ul. Zakątek, 32-708 Baczków, Poland. Email: adriannaskoczek@gmail.com.

Background: The work presents a research project carried out in hospital with participation of 100 (50 female, 50 male) patients with congenital heart defects [atrial septal defect (ASD) and patent foramen ovale (PFO)]. The aim of the study was to identify specific personality traits of patients with congenital heart defects and to check the psychological functioning of patients by examining: the level of anxiety, impulsiveness, tendency to risk-taking, empathy, neuroticism, extraversion, psychoticism and lying. The presented results and their statistical analyses showed specific personality traits of patients with congenital heart defects.

Methods: The research was conducted by psychologist Adrianna Skoczek. We performed a psychological clinical assessment and conducted the psychological tests like Eysenck Personality Questionnaire-Revised Short Version [EPQ-R(S)] and Eysenck's Impulsivity Inventory (IVE) by Hans J. Eysenck and Sybil G. Eystenck, the State-Trait Anxiety Inventory (STAI) by C. D. Spielberger, R. L. Gorsuch, R. E. Lushene describing personality traits of patients.

Results: The level of extraversion was statistically significantly higher than the level of all other variables. The level of lies was significantly different from the level of psychoticism, which in turn was statistically significantly lower than all other. In the case of the examined women, statistically significant differences were found only between the level of psychoticism and all other analyzed variables.

Conclusions: The conducted research shows that patients suffering from ASD or PFO have specific personality traits what allow to better understanding of suffering patients.

Keywords: Atrial septal defect (ASD); patent foramen ovale (PFO); personality, personality traits, congenital heart defects

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Introduction

Atrial septal defect (ASD) is the most common acyanotic heart defect. ASD occurs in 30–40% in general population of all adult patients, while persistent oval hole (PFO) in 20–25% of adult patients. Correctly constructed atrial septum consists of a primary, secondary septum, atrioventricular septum (1).

PFO

PFO is a remnant of the so-called oval opening connecting

the right and left atria of the heart in utero. After changing the pressure in the atria after birth, the oval opening closes. This process may last until the first year of life. However even in healthy people, it is not completely closed (2). Increasing pressure in the right atrium resulting in a change in flow from left-right to right-left (1,3) may be problematic. A PFO is not a heart defect, it does not require special treatment (3). PFO is associated with the risk of stroke (1) and may result in stroke, migraine headaches, and complications of decompression sickness in divers (3).

Secondary ASD

ASD, the so-called secondary ASD. A small defect of the secondary hole type can grow in the first decade of life, those measuring over 20 mm are considered large (1). In this heart defect, the main problem is the lack of continuity of the septum tissue that causes direct blood flow between the left and right atria. We distinguish secondary ASDII defects, first ASDI defects and coronary sinus defects (3).

Treatment

In the event of re-embolism into the central nervous system, the patient is directed to percutaneous closure of PFO, but first of all, if there is an atrial septal aneurysm, the next stage is antiplatelet therapy (4).

In the case of low leakage and normal pulmonary pressure, the patient does not require any medical activities or recommendations; whereas in the case of left-right leakage, invasive treatment should be performed, the decision of which is made individually depending on additional adverse circumstances; in case of tricuspid regurgitation, surgery is required (5).

According to American Heart Association/American College of Cardiology (AHA/ACC) and European Society of Cardiology (ESC), one of the most commonly used treatment methods are surgical treatment and percutaneous interventions. This applies to ASD and PFO.

The mortality associated with surgical treatment is below 1% in persons without additional disease burden. The prognosis is worse in elderly patients, especially those with additional morbidity (6,7).

The method of choice in the ASD treatment is percutaneous closure of the defect. The required condition is a maximum diameter of the defect below 38 mm and a width of the edge 5 mm along the entire circumference except for the parts at the aorta (6,7).

Such treatment is possible in approximately 80% of patients. There have been no deaths in several recent studies. About 1% of patients, however, suffered serious complications. Some patients experience transient atrial tachyarrhythmias in the peri-operative period. Atrial or aortic wall damage and thromboembolic events are very rare. It is recommended that all patients undergoing percutaneous closure of ASD have antiplatelet therapy of 100 mg or more of acetylsalicylic acid per 24 hours (6,7).

The following hypotheses were adopted:

(I) Empathy is clearly the strongest characteristic of women with congenital heart disease;
(II) A high level of psychoticism is characteristic of men suffering from a congenital heart disease;
(III) Neuroticism is characteristic of women with congenital heart disease;
(IV) Extraversion is not a characteristic feature for men with congenital heart disease;
(V) Lying is characteristic of women with congenital heart disease;
(VI) Impulsiveness is not a characteristic feature of women suffering from congenital heart disease;
(VII) Tendency to risk is characteristic of men with congenital heart disease;
(VIII) Anxiety as a condition is characteristic of women suffering from a congenital heart disease;
(IX) Anxiety as a trait is not a characteristic trait for men with congenital heart disease;
(X) Young people (<40 years old) suffering from congenital heart disease ASD are characterized by low levels of psychoticism, high anxiety as a condition and high empathy;
(XI) Elderly people (>40 years old) suffering from congenital heart disease ASD are characterized by high levels of impulsiveness and risk appetite, as well as low levels of extraversion, and high levels of lies;
(XII) Young people (<40 years old) suffering from congenital heart disease PFO are characterized by low levels of anxiety as a trait, and high levels of empathy;
(XIII) Older people (>40 years old) suffering from congenital heart disease PFO are characterized by high levels of neuroticism, low levels of lies, and low levels of impulsiveness;
(XIV) Anxiety as a condition is a characteristic feature for people suffering from ASD heart disease—before surgery;

(XV) Anxiety as a trait is a characteristic trait for people suffering from PFO heart defect—after surgery.

Objectives

We aimed to assess personality traits of clients suffer PFO and ASD in group of the woman and the man, in age ranges 0–19, 20–34, 35–49, 50–64, 65–74, 75–89 and above 90 years old; with the level of education: basic, secondary, vocational, incomplete higher, higher,; inhabiting: in the countryside, in a city up to 41,000 inhabitants, in a city of 41,000–61,000 inhabitants, a city of over 61,000 inhabitants; including marital status: marriage, divorces, widowers/widows; on employment: unemployed, employed, pensioners; before and after the procedure.

Methods

We performed a psychological clinical assessment and conducted the psychological tests like Eysenck Personality Questionnaire-Revised Short Version [EPQ-R(S)] by Hans J. Eysenck and Sybil G. Eysenck, the Eysenck's Impulsivity Inventory (IVE) by Hans J. Eysenck and Sybil G. Eystenck, the State-Trait Anxiety Inventory (STAI) by C. D. Spielberger, R. L. Gorsuch, R. E. Lushene describing personality traits of patients.

Statistical development of research results

Statistical tests were performed using IBM SPSS Statistics version 25 to test the hypotheses set out in the study.

With its help, frequency analysis, analysis of basic descriptive statistics together with the Kolmogorov-Smirnov distribution normality test, Pearson r correlation analysis, variance analysis in intra-group schemas, Mann-Whitney U tests for independent samples and Student's *t*-tests for dependent and independent samples were performed.

Results

Patients (female =50, male =50), with ASD (n=70) and with PFO (n=30); before surgery n=79, after surgery n=21; with the level of education: basic (n=5), secondary n=41, vocational n=23, incomplete higher n=4, higher n=27; residents: in the countryside n=43, in the city up to 41,000 inhabitants n=15, in the city 41,000–61,000 inhabitants n=12, a city with over 61,000 inhabitants n=30; including marital status n=20, married n=73, divorcees n=5, widower/widow n=2; on employment: the unemployed n=9, employed n=71, pensioners n=15, pensioners n=5.

The results of the EPQ-R(S) test turned out to be statistically significant, for $P<0.001$; The level of extraversion was statistically significantly higher than the level of all other variables. The level of lies was significantly different from the level of psychoticism, which in turn was statistically significantly lower than all other variables. Similarly, in the case of the IVE test, the result turned out to be statistically significant, also for $P<0.001$. In the case of the examined women, statistically significant differences were found only between the level of psychoticism and all other analyzed variables. The results of extraversion, neuroticism and lies do not differ statistically from each other, and the level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and risk tendency to risk-taking turned out to be statistically significant, there were no significant statistical differences in the field of anxiety as a condition and trait. For men, an insignificant difference was only observed between the level of neuroticism and the scale of lies; the difference between impulsiveness and tendency to risk-taking also turned out to be statistically significant, just as in the case of women no significant statistical differences were found in the field of anxiety as a condition and trait. There was no statistically significant difference between the analyzed variables of anxiety as a trait and anxiety as a condition of persons before the surgery of people suffering from ASD and after surgery in people suffering from PFO. For people over 40 years of age suffering from ASD, an insignificant difference was only observed between the levels of extraversion and lies.

The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition. In the case of people suffering from the same condition below 40 years of age, a significant difference was observed only between levels of psychoticism and other variables, i.e., neuroticism, extraversion, and lies. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned

Table 1 Basic descriptive statistics together with the distribution normality test

Psychological method	M	Mdn	SD	Sk.	Kurt.	Min	Max	K-S	P
EPQ-R(S)									
Neuroticism	5.86	6.00	3.58	0.11	–1.13	0.00	12.00	0.12	0.002
Extraversion	8.39	9.00	2.52	–0.46	–0.68	2.00	12.00	0.17	<0.001
Psychoticism	2.54	2.00	1.67	1.24	3.32	0.00	10.00	0.19	<0.001
Lies	7.21	7.00	2.77	–0.31	–0.33	0.00	12.00	0.10	0.014
IVE									
Impulsiveness	6.53	6.00	3.98	0.37	–0.74	0.00	15.00	0.13	<0.001
Tendency to risk-taking	5.86	4.00	4.01	0.69	–0.66	0.00	15.00	0.19	<0.001
Empathy	13.60	14.00	3.26	–0.94	1.37	1.00	19.00	0.13	<0.001
STAI									
Anxiety as a condition	40.46	39.00	11.09	0.31	–0.29	20.00	74.00	0.08	0.091
Anxiety as a trait	41.49	40.00	8.90	0.53	0.18	24.00	69.00	0.10	0.012

STAI, the State-Trait Anxiety Inventory; M, average; Mdn, median; SD, standard deviation; Sk., skewness; Kurt., kurtosis; Min, the lowest value; Max, highest value; K-S, Kolmogorov-Smirnov test result; EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; IVE, Eysenck's Impulsivity Inventory.

out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition. For people suffering from PFO over 40, the level of lies turned out to be statistically significantly higher only than the level of psychoticism. The level of extraversion turned out to be statistically significantly higher only than the level of psychoticism. Other comparisons were not statistically significant. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition. In people with PFO under 40, the level of extraversion turned out to be statistically significantly higher only than the level of psychoticism. In turn, the level of lies turned out to be statistically significantly higher only than the level of psychoticism. Considering the level of neuroticism, it also turned out to be statistically significantly higher only at the level of psychoticism. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition.

Basic descriptive statistics of measured quantitative variables

In order to check whether the assumption about the compliance of the distribution of measured quantitative variables with the normal distribution was met, the first analysis of basic descriptive statistics together with the Kolmogorov-Smirnov test was performed. The quantitative variables that were used to carry out the tests described later in the work were analyzed. In each case, the result of the distribution normality test turned out to be statistically significant. This means that the distributions of the analyzed variables are not normal. Nevertheless, under no circumstances does the skewness value exceed the contractual absolute value of 2 (8). The results of all calculated statistics together with the distribution normality test are presented in *Table 1*. The level of significance was assumed to be $P<0.05$.

Table 2 The severity of personality traits measured by the EPQ-R(S) tool among the women surveyed

Traits	M	SD	F	P
Neuroticism	0.57	0.29	34.96	<0.001
Extraversion	0.65	0.23		
Psychoticism	0.22	0.15		
Lies	0.65	0.23		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; M, average; SD, standard deviation.

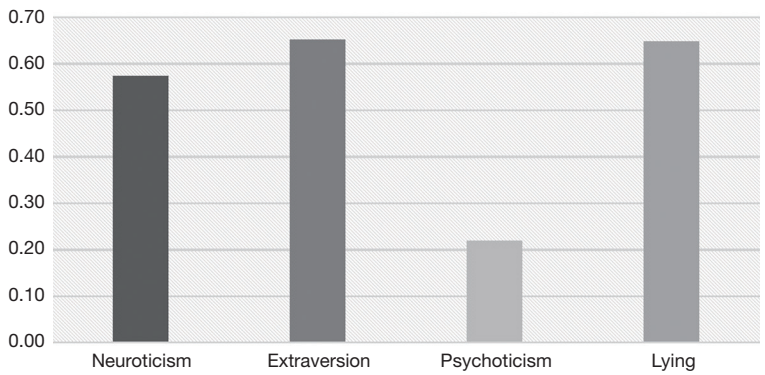

Figure 1 The average of the analyzed dimensions of the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck for the examined women. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version.

Congenital heart disease and personality traits among women

Analyzes were carried out among a group of women. First, an analysis of the variance of results obtained by the examined women on the scales of the tool EPQ-R(S) (9) was performed. Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result proved to be statistically significant [F (2.40; 117.40) =34.96; P<0.001; η2 =0.42]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. Statistically significant differences were found only between the level of psychoticism and all other analyzed variables. The results of extraversion, neuroticism and lies do not differ statistically significantly. The discussed average values are presented in *Table 2* and *Figure 1*.

Then, an analogous analysis of the variance of results obtained was carried out on the scales of the IVE tool (10). The test result proved to be statistically significant [F (2, 98) =95.71; P<0.001; η2 =0.66]. The eta value of the square indicates that the observed effect is very strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking also turned out to be statistically significant. The values of the discussed means and the result of the analysis of variance are presented in *Table 3* and *Figure 2*.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by the examined women on the scales of the STAI tool (11) were compared with each other.

Based on the results presented in *Table 4*, no statistically significant difference was found between the analyzed variables. The compared means are illustrated in *Figure 3*.

Congenital heart disease and personality traits among men

Then, similar analyzes were carried out among the studied men. First, the analysis of variance results obtained on the tool scales EPQ-R(S) (9). Due to violation of the assumption

Table 3 The severity of personality traits measured by the IVE tool Hans J. Eysenck and Sybil G. Eysenck among the women surveyed

Traits	M	SD	F	P
Impulsiveness	0.35	0.21	95.71	<0.001
Tendency to risk-taking	0.26	0.21		
Empathy	0.75	0.17		

IVE, Eysenck's Impulsivity Inventory; M, average; SD, standard deviation.

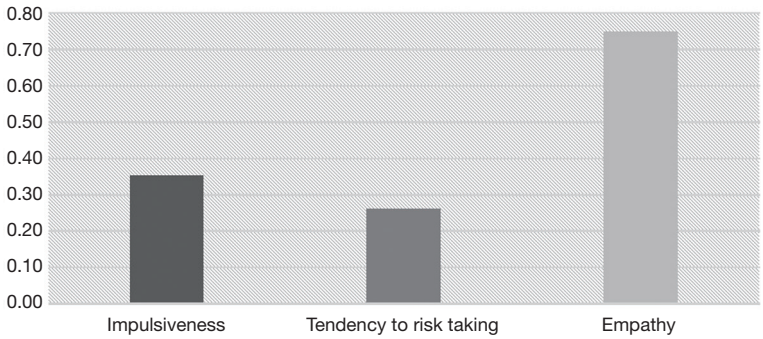

Figure 2 Average of analyzed dimensions of the IVE tool Hans J. Eysenck and Sybil G. Eysenck for the examined women. IVE, Eysenck's Impulsivity Inventory.

Table 4 The severity of traits measured with the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among the examined women

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.22	0.46	0.05	0.961	–0.16	0.17	0.00
Anxiety as a condition	2.22	0.56					

STAI, the State-Trait Anxiety Inventory; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

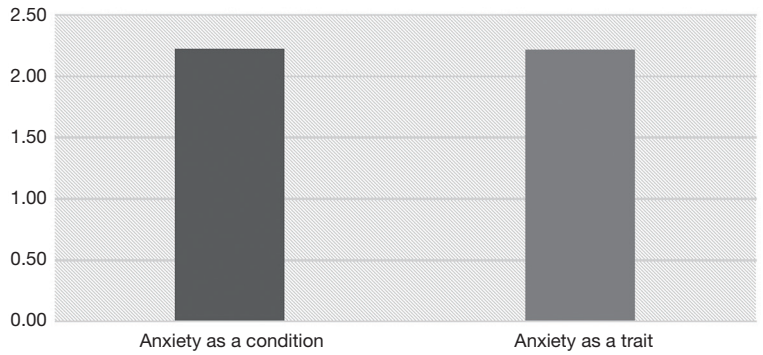

Figure 3 The average of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for the examined women. STAI, the State-Trait Anxiety Inventory.

Table 5 The severity of personality traits measured by the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck among the surveyed men

Traits	M	SD	F	P
Neuroticism	0.40	0.28	53.41	<0.001
Extraversion	0.75	0.18		
Psychoticism	0.21	0.13		
Lies	0.55	0.22		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; M, average; SD, standard deviation.

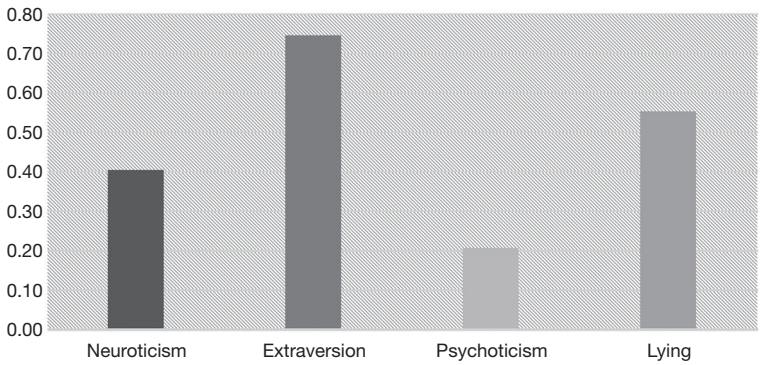

Figure 4 The average of the analyzed dimensions of the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck for the examined men. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version.

Table 6 The intensification of personality traits measured by the IVE tool Hans J. Eysenck and Sybil G. Eysenck among the surveyed men

Traits	M	SD	F	P
Impulsiveness	0.34	0.21	36.63	<0.001
Tendency to risk-taking	0.47	0.25		
Empathy	0.68	0.17		

IVE, Eysenck's Impulsivity Inventory; M, average; SD, standard deviation.

about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result turned out to be statistically significant [F (2.35; 115.35) =53.41; P<0.001; η2 =0.52]. The eta value of the square indicates that the observed effect is very strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. An insignificant difference was only observed between the level of neuroticism and the scale of lies. The discussed average is presented in *Table 5* and *Figure 4*.

Then, an analogous analysis of the variance of results obtained on the IVE scales was carried out by (10). Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result proved to be statistically significant [F (1.78; 87.31) =36.63; P<0.001; η2 =0.43]. The eta value of the square indicates that the observed effect is very strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking also turned out to be statistically significant. The values of the discussed means and the result of the analysis of variance are presented in *Table 6* and *Figure 5*.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by the

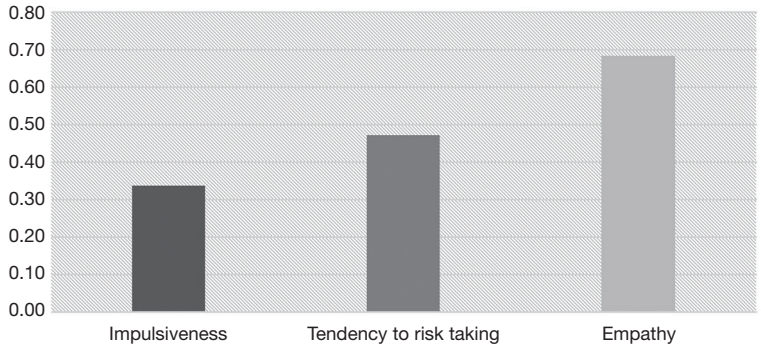

Figure 5 Average of analyzed dimensions of IVE tool Hans J. Eysenck and Sybil G. Eysenck for the examined men. IVE, Eysenck's Impulsivity Inventory.

Table 7 The severity of traits measured by the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among the examined men

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	1.83	0.47	–2.17	0.035	–0.21	–0.01	0.25
Anxiety as a condition	1.93	0.38					

STAI, the State-Trait Anxiety Inventory; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

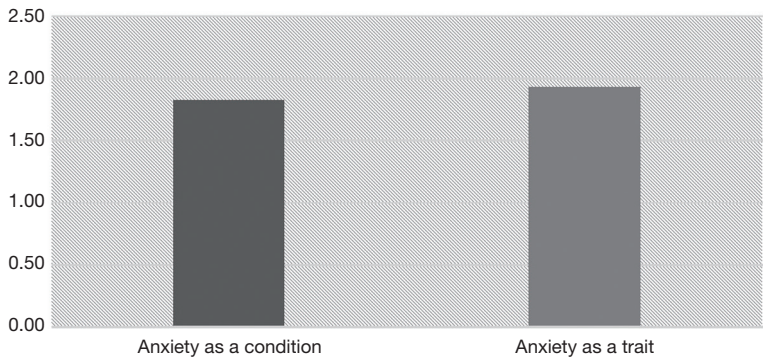

Figure 6 Average of the analyzed dimensions of the STAI tool for the examined men. STAI, the State-Trait Anxiety Inventory.

examined men on the scales of the STAI tool (11) were compared with each other.

Based on the results presented in *Table 7*, a statistically significant difference was found between the analyzed variables. The compared means are illustrated in *Figure 6*.

Personality traits among patients with ASD before the surgery

To verify the next hypothesis, a Student's *t*-test was carried out for dependent samples. The results obtained on the scales of the STAI tool (11) were compared by the respondents with ASD defect before surgery. Based on the results presented in *Table 8*, no statistically significant difference was found between the analyzed variables. The compared means are illustrated in *Figure 7*.

Personality traits among patients with PFO defect after surgery

To verify the next hypothesis, a Student's *t*-test was carried

Table 8 Strength of features measured with the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among subjects with ASD defect prior to surgery

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.01	0.40	0.28	0.781	–0.10	0.13	0.04
Anxiety as a condition	2.03	0.52					

STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect; N, number of observations; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

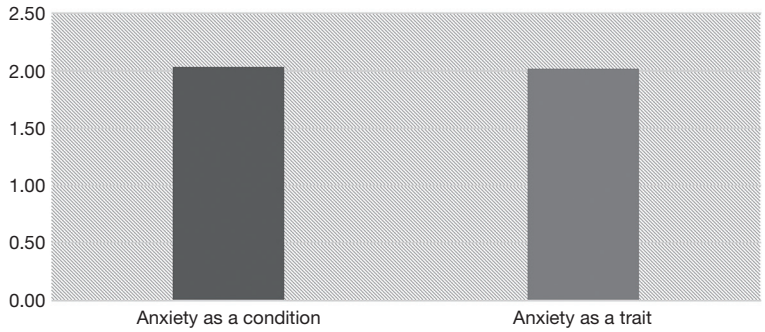

Figure 7 Mean of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects with ASD defect before surgery. STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect.

out for dependent samples. The results obtained on the scales of the STAI tool (11) were compared by subjects with a PFO defect after surgery. Based on the results presented in *Table 9*, no statistically significant difference was found between the analyzed variables. The compared means are illustrated in *Figure 8*.

Congenital heart disease ASD and personality traits in the group over 40 years of age

In order to verify the next hypothesis, analogous analyzes were carried out, but among those with ASD over 40. First, an analysis of the variance of results obtained by this group of subjects on the scales of the EPQ-R(S) (9) tool was performed. Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result turned out to be statistically significant [F (2.34; 103.10) =37.52; P<0.001; η2 =0.46]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. An insignificant difference was only observed between the levels of extraversion and lies. The discussed average is presented in *Table 10* and *Figure 9*.

Then, an analogous analysis of the variance of results obtained on the IVE scales was carried out (10). Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result turned out to be statistically significant [F (1.54; 67.91) =46.61; P<0.001; η2 =0.51]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned out to be statistically insignificant. The values of the discussed means and the result of the analysis of variance are presented in *Table 11* and *Figure 10*.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by subjects over 40 years old with ASD defect were compared with each other on the scales of the STAI tool (11). Based on the results presented in *Table 12*, no statistically significant differences were found between the analyzed variables. The compared means are illustrated in *Figure 11*.

Table 9 Intensification of features measured with the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among patients with PFO defect after surgery

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	1.73	0.25	1.53	0.267	–0.30	0.64	0.90
Anxiety as a condition	1.90	0.09					

STAI, the State-Trait Anxiety Inventory; PFO, patent foramen ovale; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

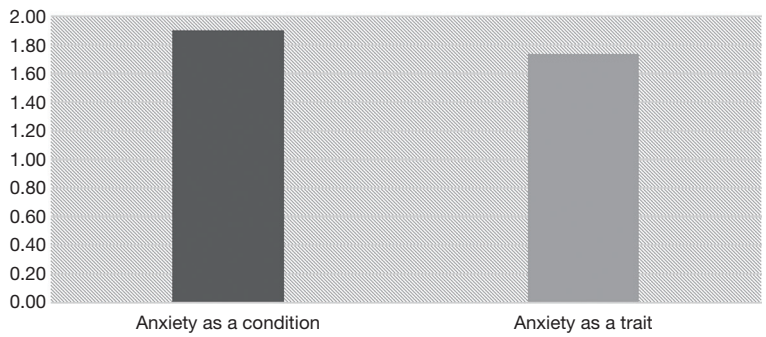

Figure 8 The average of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects with PFO defect after surgery. STAI, the State-Trait Anxiety Inventory; PFO, patent foramen ovale.

Table 10 Intensification of personality traits measured with the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck among those over 40 years old with ASD

Traits	M	SD	F	P
Neuroticism	0.43	0.29	37.52	<0.001
Extraversion	0.71	0.19		
Psychoticism	0.24	0.14		
Lies	0.61	0.23		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; ASD, atrial septal defect; M, average; SD, standard deviation.

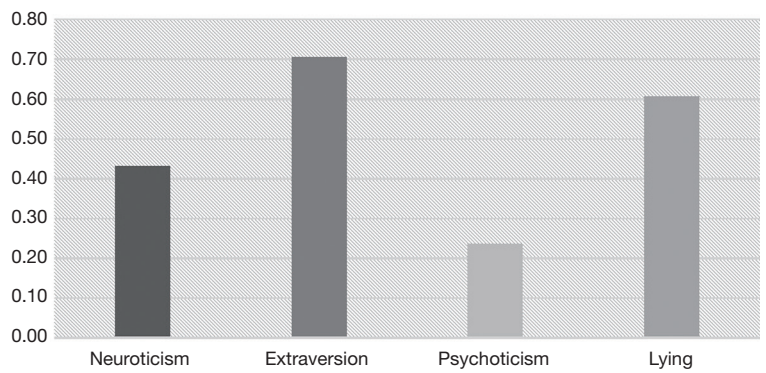

Figure 9 Average of the dimensions of the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck for subjects over 40 years old with ASD. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; ASD, atrial septal defect.

Table 11 The severity of personality traits measured with the IVE tool Hans J. Eysenck and Sybil G. Eysenck among those over 40 years old with ASD

Traits	M	SD	F	P
Impulsiveness	0.33	0.19	46.61	<0.001
Tendency to risk-taking	0.39	0.28		
Empathy	0.72	0.15		

IVE, Eysenck's Impulsivity Inventory; ASD, atrial septal defect; M, average; SD, standard deviation.

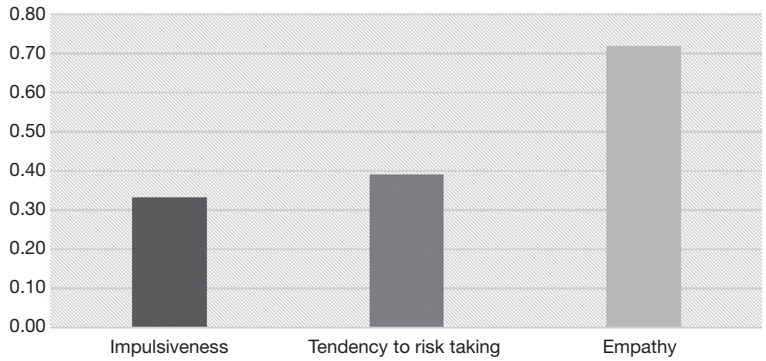

Figure 10 Average of analyzed dimensions of IVE tool Hans J. Eysenck and Sybil G. Eysenck for subjects over 40 years old with ASD. IVE, Eysenck's Impulsivity Inventory; ASD, atrial septal defect.

Table 12 The severity of personality traits measured with the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among those over 40 years old with ASD

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.01	0.41	−0.55	0.589	−0.20	0.11	0.11
Anxiety as a condition	1.96	0.50					

STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

Congenital heart disease ASD and personality traits in the group under 40 years of age

In order to verify the next hypothesis, analogous analyzes were carried out, but among those with ASD under the age of 40. First, an analysis of the variance of results obtained by this group of subjects on the scales of the tool EPQ-R(S) (9) was performed. Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result turned out to be statistically significant [F (1.94; 40.68) =23.99; P<0.001; η2 =0.53]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. A significant difference was observed only between levels of psychoticism and other variables. The discussed averages are presented in *Table 13* and *Figure 12*.

Then, an analogous analysis of the variance of results obtained on the IVE scales was carried out (10). The test result turned out to be statistically significant [F (2, 42) =10.89; P<0.001; η2 =0.34]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than

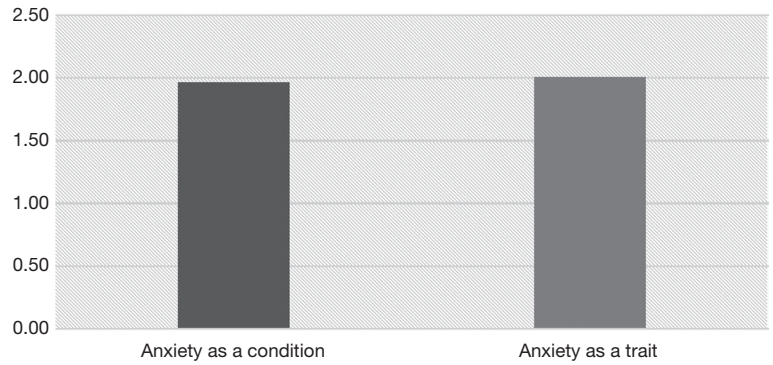

Figure 11 The average of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects over 40 years old with ASD defect. STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect.

Table 13 The severity of personality traits measured with the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck among those under 40 with ASD

Traits	M	SD	F	P
Neuroticism	0.57	0.30	23.99	<0.001
Extraversion	0.73	0.19		
Psychoticism	0.16	0.10		
Lies	0.56	0.23		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; ASD, atrial septal defect; M, average; SD, standard deviation.

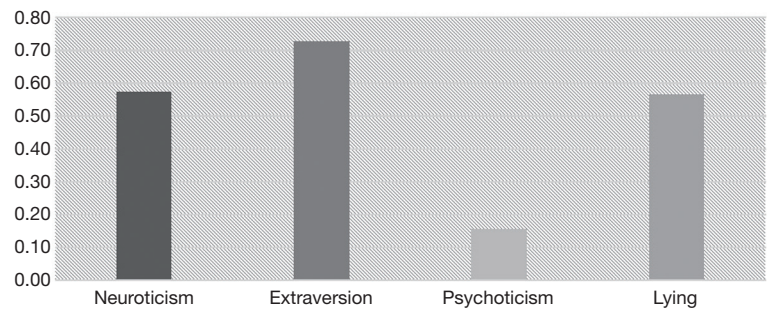

Figure 12 Average of the dimensions of the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck for subjects under 40 years old with ASD. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; ASD, atrial septal defect.

the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and tendency to risk-taking turned out to be statistically insignificant. The values of the discussed means and the result of the analysis of variance are presented in *Table 14* and *Figure 13*.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by subjects under 40 with ASD defect were compared with each other on the scales of the STAI tool (11). Based on the results presented in *Table 15*, no statistically significant differences were found between the analyzed variables. The compared means are illustrated in *Figure 14*.

PFO congenital heart disease and personality traits in the group over 40 years old

In order to verify the next hypothesis, analogous analyzes were carried out, but among those over 40 years old with

Table 14 The severity of personality traits measured with the IVE tool Hans J. Eysenck and Sybil G. Eysenck among those under 40 with ASD

Traits	M	SD	F	P
Impulsiveness	0.41	0.23	10.89	<0.001
Tendency to risk-taking	0.41	0.22		
Empathy	0.68	0.23		

IVE, Eysenck's Impulsivity Inventory; ASD, atrial septal defect; M, average; SD, standard deviation.

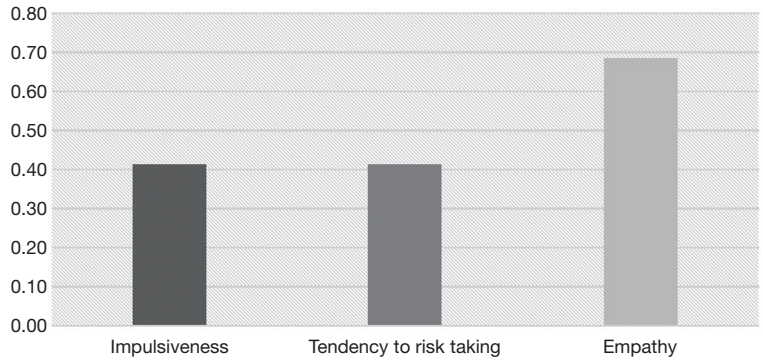

Figure 13 Average of analyzed dimensions of IVE tool Hans J. Eysenck and Sybil G. Eysenck for subjects under 40 years of age with ASD. IVE, Eysenck's Impulsivity Inventory; ASD, atrial septal defect.

Table 15 The severity of personality traits measured by the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among those under 40 with ASD

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.09	0.47	0.62	0.54	−0.14	0.26	0.11
Anxiety as a condition	2.15	0.62					

STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

PFO defect. First, an analysis of the variance of results obtained by this group of subjects on the scales of the tool EPQ-R(S) (9) was performed. The test result proved to be statistically significant [F (3, 42) =7.79; P<0.001; η2 =0.36]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of lies turned out to be statistically significantly higher only than the level of psychoticism. The level of extraversion turned out to be statistically significantly higher only than the level of psychoticism. Other comparisons were not statistically significant. The discussed average is presented in *Table 16* and *Figure 15*.

Then, an analogous analysis of the variance of results obtained on the IVE scales was carried out (11). The test result turned out to be statistically significant [F (2, 28) =29.63; P<0.001; η2 =0.68]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. The difference between impulsiveness and risk tendency to risk-taking turned out to be statistically insignificant. The values of the discussed averages and the result of the analysis of variance are presented in *Table 17* and *Figure 16*.

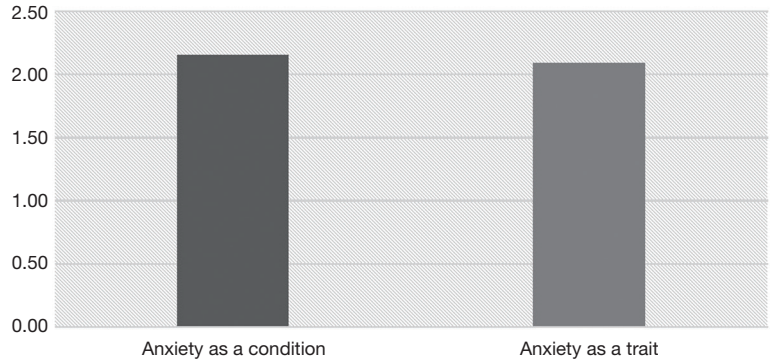

Figure 14 The average of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects under 40 with ASD. STAI, the State-Trait Anxiety Inventory; ASD, atrial septal defect.

Table 16 The severity of personality traits measured by the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck among those over 40 years old with a PFO defect

Traits	M	SD	F	P
Neuroticism	0.45	0.31	7.79	<0.001
Extraversion	0.64	0.25		
Psychoticism	0.28	0.18		
Lies	0.67	0.19		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; PFO, patent foramen ovale; M, average; SD, standard deviation.

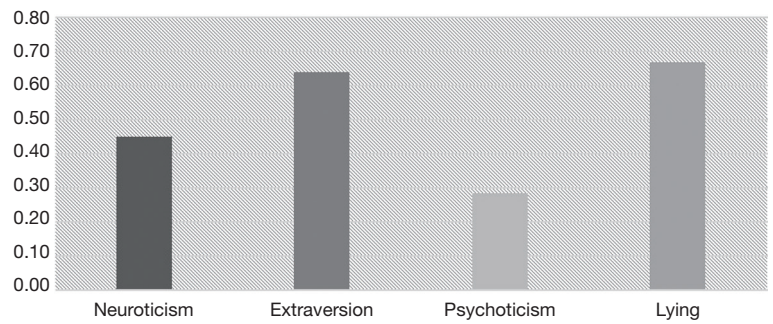

Figure 15 The average of the dimensions of the analyzed tool EPQ-R(S) Hans J. Eysenck and Sybil G. Eysenck for subjects over 40 years old with a PFO defect. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; PFO, patent foramen ovale.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by subjects under 40 with ASD defect were compared with each other on the scales of the STAI tool (11). Based on the results presented in *Table 18*, no statistically significant differences were found between the analyzed variables. The compared means are illustrated in *Figure 17*.

PFO congenital heart disease and personality traits in the group under 40 years of age

In order to verify the next hypothesis, analogous analyzes were carried out, but among those under the age of 40 with PFO defect. First, an analysis of the variance of results obtained by this group of subjects on the scales of

Table 17 The severity of personality traits measured with the IVE tool Hans J. Eysenck and Sybil G. Eysenck among those over 40 years old with PFO defect

Traits	M	SD	F	P
Impulsiveness	0.30	0.20	29.63	<0.001
Tendency to risk-taking	0.27	0.22		
Empathy	0.74	0.19		

IVE, Eysenck's Impulsivity Inventory; PFO, patent foramen ovale; M, average; SD, standard deviation.

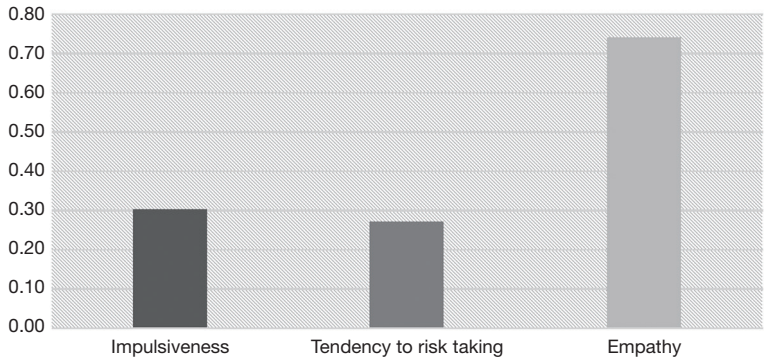

Figure 16 Average of the analyzed dimensions of the IVE tool Hans J. Eysenck and Sybil G. Eysenck for subjects over 40 years old with PFO defect. IVE, Eysenck's Impulsivity Inventory; PFO, patent foramen ovale.

Table 18 The severity of personality traits measured by the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among those over 40 years old with PFO defect

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.22	0.52	−1.48	0.161	−0.45	0.08	0.36
Anxiety as a condition	2.04	0.49					

STAI, the State-Trait Anxiety Inventory; PFO, patent foramen ovale; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval.

the tool EPQ-R(S) (9) was performed. Due to violation of the assumption about the sphericity of variables, the Greenhouse-Geisser correction was applied in reporting the result of the analysis. The test result turned out to be statistically significant [F (2.03; 24.35) =13.54; P<0.001; η2 =0.53]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of extraversion turned out to be statistically significantly higher only than the level of psychoticism. In turn the level of lies turned out to be statistically significantly higher only than the level of psychoticism. Considering the level of neuroticism, it also turned out to be statistically significantly higher only at the level of psychoticism. The discussed average is presented in *Table 19* and *Figure 18*.

Then, an analogous analysis of the variance of results obtained on the IVE (10) tool scales was performed. The test result turned out to be statistically significant [F (2, 24) =14.03; P<0.001; η2 =0.54]. The eta value of the square indicates that the observed effect is strong. In order to check the essence of this effect, a *post hoc* analysis (with Bonferroni correction) was carried out. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. The difference between impulsiveness and risk appetite turned out to be statistically

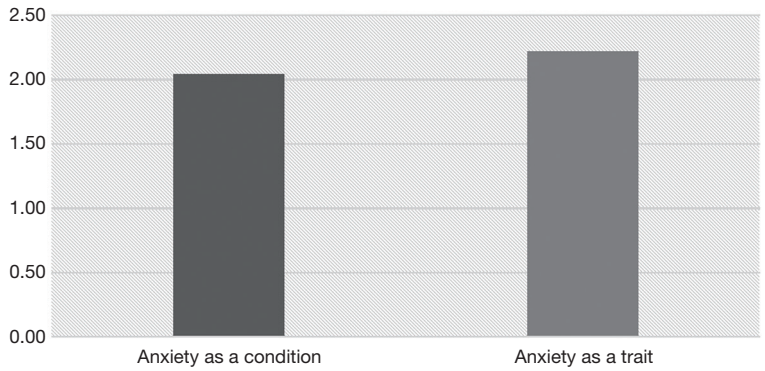

Figure 17 Average of the dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects over 40 years old with PFO defect. PFO, patent foramen ovale.

Table 19 The severity of personality traits measured with the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck among those under 40 years of age with a PFO defect

Traits	M	SD	F	P
Neuroticism	0.45	0.25	13.54	<0.001
Extraversion	0.73	0.23		
Psychoticism	0.13	0.10		
Lies	0.60	0.30		

EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; PFO, patent foramen ovale; M, average; SD, standard deviation.

insignificant. The values of the discussed means and the result of the analysis of variance are presented in *Table 20* and *Figure 19*.

Then the Student's *t*-test analysis for repeated measurements was performed. The results obtained by respondents under 40 with a PFO defect were compared with each other on the scales of the STAI tool (11). Based on the results presented in *Table 21*, no statistically significant differences were found between the analyzed variables. The compared means are illustrated in *Figure 20*.

Discussion

In the case of women statistically significant differences were found between the level of psychoticism and all other analyzed variables. The results of extraversion, neuroticism and lies do not differ statistically from each other, and the level of declared empathy is statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. On the other hand, the difference between impulsiveness and tendency to risk-taking turned out to be also statistically significant, no significant statistical differences were found in the scope of anxiety as a condition and feature.

For men, an insignificant difference was only observed between the level of neuroticism and the scale of lies; the difference between impulsiveness and risk appetite also turned out to be statistically significant, just as in the case of women no significant statistical differences were found in the field of anxiety as a condition and trait.

There was no statistically significant difference between the analyzed variables of anxiety as a trait and anxiety as a condition in people before the surgery of people suffering from ASD and after surgery in people suffering from PFO.

For people over 40 years of age suffering from ASD, an insignificant difference was only observed between the levels of extraversion and lies. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. The difference between impulsiveness and risk appetite turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition.

In the case of people suffering from the same condition below 40 years of age, a significant difference was observed

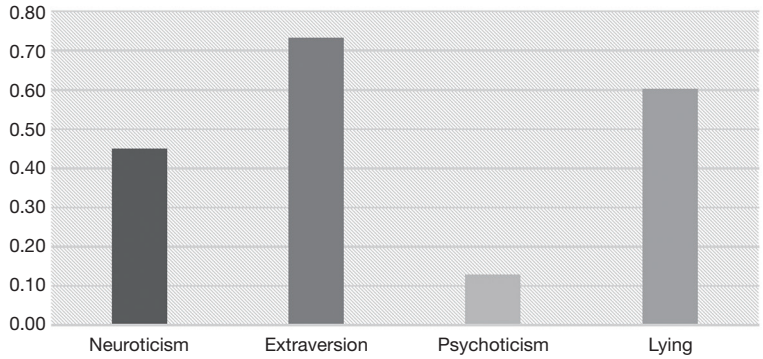

Figure 18 The mean of the analyzed dimensions of the EPQ-R(S) tool Hans J. Eysenck and Sybil G. Eysenck for subjects under 40 years of age with a PFO defect. EPQ-R(S), Eysenck Personality Questionnaire-Revised Short Version; PFO, patent foramen ovale.

Table 20 The severity of personality traits measured with the IVE tool by Hans J. Eysenck and Sybil G. Eysenck among those under 40 years of age with PFO defect

Traits	M	SD	F	P
Impulsiveness	0.28	0.24	14.03	<0.001
Tendency to risk-taking	0.35	0.21		
Empathy	0.71	0.16		

IVE, Eysenck's Impulsivity Inventory; PFO, patent foramen ovale; M, average; SD, standard deviation.

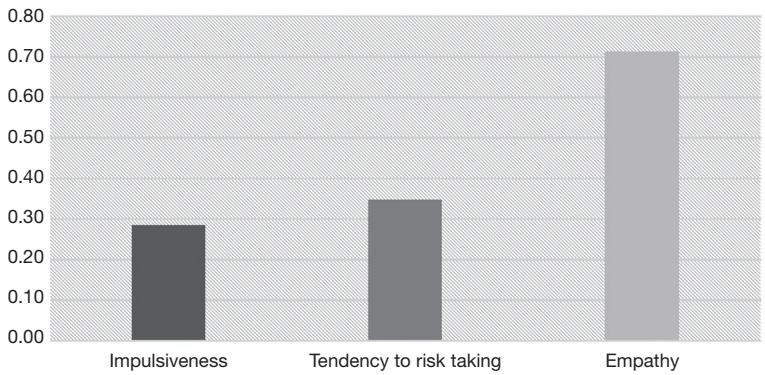

Figure 19 Average of analyzed dimensions of IVE tool Hans J. Eysenck and Sybil G. Eysenck for subjects under 40 years of age with PFO defect. IVE, Eysenck's Impulsivity Inventory; PFO, patent foramen ovale.

only between levels of psychoticism and other variables, i.e., neuroticism, extraversion, and lies. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. The difference between impulsiveness and risk appetite turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition.

For people suffering from PFO over 40, the level of lies turned out to be statistically significantly higher only than the level of psychoticism. The level of extraversion turned out to be statistically significantly higher than the level of psychoticism. Other comparisons were not statistically significant. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk

Table 21 The severity of personality traits measured with the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene among those under 40 years of age with PFO defect

Features	M	SD	*t*	P	95% CI		d Cohena
					LL	UL	
Anxiety as a trait	2.09	0.39	−1.81	0.095	−0.45	0.04	0.35
Anxiety as a condition	1.89	0.70					

STAI, the State-Trait Anxiety Inventory; M, average; SD, standard deviation; CI, confidence interval for the difference between means; LL and UL, lower and upper limits of the confidence interval; PFO, patent foramen ovale.

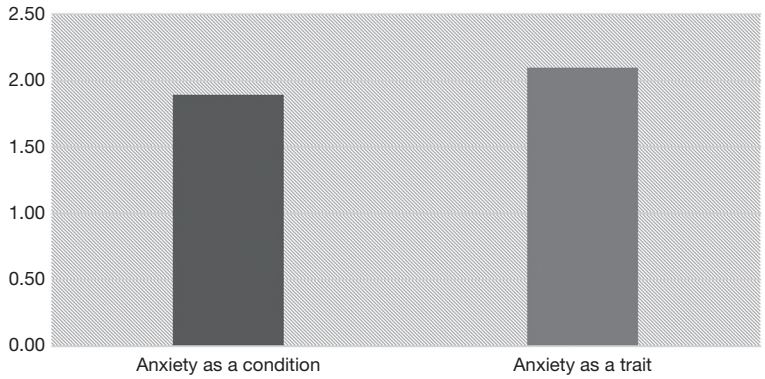

Figure 20 Average of the analyzed dimensions of the STAI tool C. D. Spielberger, R. L. Gorsuch, R. E. Lushene for subjects under 40 years of age life with a disadvantage of PFO. IVE, Eysenck's Impulsivity Inventory; PFO, patent foramen ovale.

propensity. The difference between impulsiveness and risk appetite turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition.

In people with PFO under 40, the level of extraversion turned out to be statistically significantly higher than the level of psychoticism. However, the level of lies turned out to be only higher than the level of psychoticism. Considering the level of neuroticism, it also turned out to be statistically significantly higher in terms of psychoticism. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. The difference between impulsiveness and risk appetite turned out to be statistically insignificant. Based on the results, no statistically significant differences were found between the analyzed variables—anxiety as a trait and anxiety as a condition.

In the case of women the level of declared empathy is statistically significantly higher than the levels of impulsiveness and tendency to risk-taking. On the other hand, the difference between impulsiveness and tendency to risk-taking turned out to be also statistically significant. For men, an insignificant difference was only observed between the level of neuroticism and the scale of lies; the difference between impulsiveness and risk appetite also turned out to be statistically significant, just as in the case of women no significant statistical differences were found in the field of anxiety as a condition and trait. For people over 40 years of age suffering from ASD, an insignificant difference was only observed between the levels of extraversion and lies. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. In the case of people suffering from the same condition below 40 years of age, a significant difference was observed only between levels of psychoticism and other variables, i.e., neuroticism, extraversion, and lies. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity. For people suffering from PFO over 40, the level of lies turned out to be statistically significantly higher only than the level of psychoticism. The level of extraversion turned out to be statistically significantly higher than the level of psychoticism. The level of declared empathy was statistically

significantly higher than the levels of impulsiveness and risk propensity. In people with PFO under 40, the level of extraversion turned out to be statistically significantly higher than the level of psychoticism. However, the level of lies turned out to be only higher than the level of psychoticism. Considering the level of neuroticism, it also turned out to be statistically significantly higher in terms of psychoticism. The level of declared empathy was statistically significantly higher than the levels of impulsiveness and risk propensity.

Conclusions

The conducted research shows that patients suffering from ASD or PFO have specific personality traits what allow to better understanding of suffering patients.

Acknowledgments

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jtd-20-220). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by Bioethics Commission of Jagiellonian University in Cracow (No. 1072.6120.132.2017 from 28th September 2017) and informed consent was taken from all the patients. All patients agreed to the examination (part of the studies completed before the surgery, some after the surgery). Patients expressed willingness to participate in the operation, and the study submitted reported and approved by the bioethics committee. The study involved completing three psychological tests (EPQ-R, IVE, STAI) examining the personality structure and level of anxiety. This article does not contain any studies with human participants performed by any of the authors. This article does not contain any studies with animals performed by any of the authors. This article does not contain any studies with human participants or animals performed by any of the authors.

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